

# SN54LV374, SN74LV374 OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCLS197B – FEBRUARY 1993 – REVISED APRIL 1996

- **EPIC™ (Enhanced-Performance Implanted CMOS) 2-μ Process**
- **Typical  $V_{OLP}$  (Output Ground Bounce)  $< 0.8$  V at  $V_{CC}$ ,  $T_A = 25^\circ\text{C}$**
- **Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot)  $> 2$  V at  $V_{CC}$ ,  $T_A = 25^\circ\text{C}$**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model ( $C = 200$  pF,  $R = 0$ )**
- **Latch-Up Performance Exceeds 250 mA Per JEDEC Standard JESD-17**
- **Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), Thin Shrink Small-Outline (PW), Ceramic Flat (W) Packages, Chip Carriers (FK), and (J) 300-mil DIPs**

## description

These octal edge-triggered D-type flip-flops are designed for 2.7-V to 5.5-V  $V_{CC}$  operation.

The 'LV374 feature 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. These devices are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels set up at the data (D) inputs.

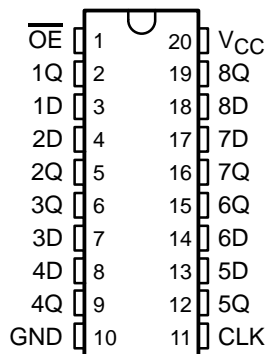
A buffered output-enable ( $\overline{OE}$ ) input can be used to place the eight outputs in either as normal logic state (high or low logic levels) or high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased drive provide the capability to drive bus lines without need for interface or pullup components.

$\overline{OE}$  does not affect internal operations of the latch. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

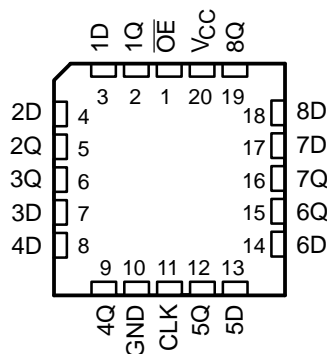
The SN74LV374 is available in TI's shrink small-outline package (DB), which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54LV374 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74LV374 is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN54LV374 . . . J OR W PACKAGE  
SN74LV374 . . . DB, DW, OR PW PACKAGE  
(TOP VIEW)



SN54LV374 . . . FK PACKAGE  
(TOP VIEW)



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**TEXAS  
INSTRUMENTS**

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# SN54LV374, SN74LV374

## OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS

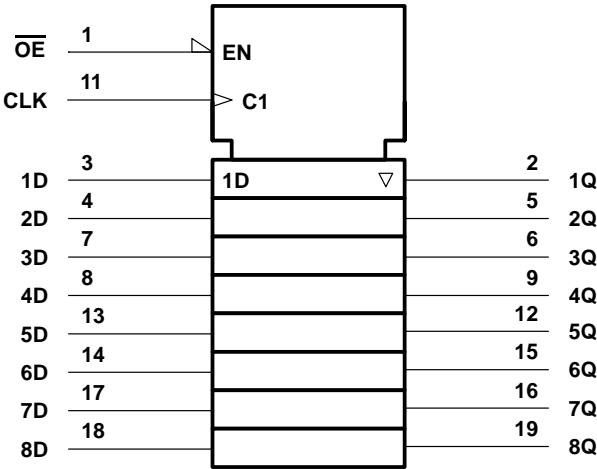
### WITH 3-STATE OUTPUTS

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FUNCTION TABLE  
(each flip-flop)

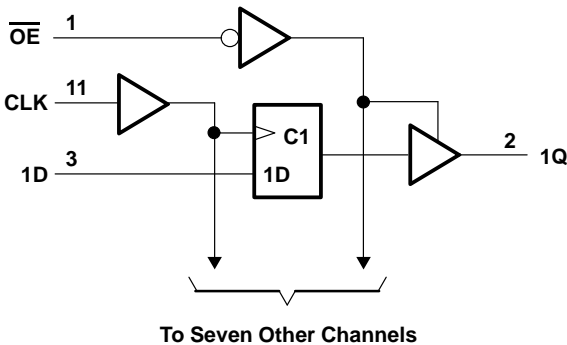
| INPUTS          |     |   | OUTPUT<br>Q |
|-----------------|-----|---|-------------|
| $\overline{OE}$ | CLK | D |             |
| L               | ↑   | H | H           |
| L               | ↑   | L | L           |
| L               | L   | X | $Q_0$       |
| H               | X   | X | Z           |

#### logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.  
Pin numbers shown are for DB, DW, J, PW, and W packages.

#### logic diagram (positive logic)



#### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)‡

|  |                            |
|--|----------------------------|
| Supply voltage range, $V_{CC}$   | –0.5 V to 7 V              |
| Input voltage range, $V_I$ (see Note 1)  | –0.5 V to $V_{CC} + 0.5$ V |
| Output voltage range, $V_O$ (see Notes 1 and 2)                                    | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ )                      | ±20 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ )                     | ±50 mA                     |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )                         | ±35 mA                     |
| Continuous current through $V_{CC}$ or GND   | ±70 mA                     |
| Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3): |                            |
| DB package   | 0.6 W                      |
| DW package   | 1.6 W                      |
| PW package   | 0.7 W                      |
| Storage temperature range, $T_{stg}$   | –65°C to 150°C             |

‡ Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
  2. This value is limited to 7 V maximum.
  3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

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## OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

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#### recommended operating conditions (see Note 4)

|                       |                                    |  | SN54LV374 |          | SN74LV374 |          | UNIT |
|-----------------------|------------------------------------|--|-----------|----------|-----------|----------|------|
|                       |                                    |  | MIN       | MAX      | MIN       | MAX      |      |
| $V_{CC}$              | Supply voltage                     |  | 2.7       | 5.5      | 2.7       | 5.5      | V    |
| $V_{IH}$              | High-level input voltage           | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ | 2         |          | 2         |          | V    |
|                       |                                    | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ | 3.15      |          | 3.15      |          |      |
| $V_{IL}$              | Low-level input voltage            | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ |           | 0.8      |           | 0.8      | V    |
|                       |                                    | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ |           | 1.65     |           | 1.65     |      |
| $V_I$                 | Input voltage                      |  | 0         | $V_{CC}$ | 0         | $V_{CC}$ | V    |
| $V_O$                 | Output voltage                     |  | 0         | $V_{CC}$ | 0         | $V_{CC}$ | V    |
| $I_{OH}$              | High-level output current          | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ |           | -8       |           | -8       | mA   |
|                       |                                    | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ |           | -16      |           | -16      |      |
| $I_{OL}$              | Low-level output current           | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ |           | 8        |           | 8        | mA   |
|                       |                                    | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ |           | 16       |           | 16       |      |
| $\Delta t / \Delta v$ | Input transition rise or fall rate |  | 0         | 100      | 0         | 100      | ns/V |
| $T_A$                 | Operating free-air temperature     |  | -55       | 125      | -40       | 85       | °C   |

NOTE 4: Unused inputs must be held high or low to prevent them from floating.

#### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER       | TEST CONDITIONS  | $V_{CC}^\dagger$ | SN54LV374      |     |         | SN54LV374      |     |         | UNIT          |
|-----------------|--|------------------|----------------|-----|---------|----------------|-----|---------|---------------|
|                 |  |                  | MIN            | TYP | MAX     | MIN            | TYP | MAX     |               |
| $V_{OH}$        | $I_{OH} = -100 \mu\text{A}$  | MIN to MAX       | $V_{CC} - 0.2$ |     |         | $V_{CC} - 0.2$ |     |         | V             |
|                 | $I_{OH} = -8 \text{ mA}$   | 3 V              | 2.4            |     |         | 2.4            |     |         |               |
|                 | $I_{OH} = -16 \text{ mA}$  | 4.5 V            | 3.6            |     |         | 3.6            |     |         |               |
| $V_{OL}$        | $I_{OL} = 100 \mu\text{A}$   | MIN to MAX       |                |     | 0.2     |                |     | 0.2     | V             |
|                 | $I_{OL} = 8 \text{ mA}$  | 3 V              |                |     | 0.4     |                |     | 0.4     |               |
|                 | $I_{OL} = 16 \text{ mA}$   | 4.5 V            |                |     | 0.55    |                |     | 0.55    |               |
| $I_I$           | $V_I = V_{CC} \text{ or GND}$  | 3.6 V            |                |     | $\pm 1$ |                |     | $\pm 1$ | $\mu\text{A}$ |
|                 |  | 5.5 V            |                |     | $\pm 1$ |                |     | $\pm 1$ |               |
| $I_{OZ}$        | $V_O = V_{CC} \text{ or GND}$  | 3.6 V            |                |     | $\pm 5$ |                |     | $\pm 5$ | $\mu\text{A}$ |
|                 |  | 5.5 V            |                |     | $\pm 5$ |                |     | $\pm 5$ |               |
| $I_{CC}$        | $V_I = V_{CC} \text{ or GND, } I_O = 0$  | 3.6 V            |                |     | 20      |                |     | 20      | $\mu\text{A}$ |
|                 |  | 5.5 V            |                |     | 20      |                |     | 20      |               |
| $\Delta I_{CC}$ | One input at $V_{CC} - 0.6 \text{ V}$ ,<br>Other inputs at $V_{CC} \text{ or GND}$ | 3 V to 3.6 V     |                |     | 500     |                |     | 500     | $\mu\text{A}$ |
| $C_i$           | $V_I = V_{CC} \text{ or GND}$  | 3.3 V            |                | 2.5 |         |                | 2.5 |         | pF            |
|                 |  | 5 V              |                | 3   |         |                | 3   |         |               |
| $C_o$           | $V_O = V_{CC} \text{ or GND}$  | 3.3 V            |                | 7   |         |                | 7   |         | pF            |
|                 |  | 5 V              |                | 8   |         |                | 8   |         |               |

<sup>†</sup> For conditions shown as MIN or MAX, use the appropriate values under recommended operating conditions.

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# SN54LV374, SN74LV374

## OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

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timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

|                    |                                 |  |             | SN54LV374                        |     |                                    |     |                         |     | UNIT |
|--------------------|---------------------------------|--|-------------|----------------------------------|-----|------------------------------------|-----|-------------------------|-----|------|
|                    |                                 |  |             | V <sub>CC</sub> = 5 V<br>± 0.5 V |     | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |     | V <sub>CC</sub> = 2.7 V |     |      |
|                    |                                 |  |             | MIN                              | MAX | MIN                                | MAX | MIN                     | MAX |      |
| f <sub>clock</sub> | Clock frequency                 |  |             | 0                                | 45  | 0                                  | 40  | 0                       | 35  | MHz  |
| t <sub>w</sub>     | Pulse duration, CLK high or low |  |             | 9                                |     | 10                                 |     | 13                      |     | ns   |
| t <sub>su</sub>    | Setup time before CLK↑          |  | High or low | 7                                |     | 10                                 |     | 11                      |     | ns   |
| t <sub>h</sub>     | Hold time, data after CLK↑      |  |             | 3                                |     | 2                                  |     | 2                       |     | ns   |

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

|                    |                                 |  |             | SN74LV374                                   |     |   |     |                         |     | UNIT |
|--------------------|---------------------------------|--|-------------|---|-----|---|-----|-------------------------|-----|------|
|                    |                                 |  |             | $V_{CC} = 5\text{ V}$<br>$\pm 0.5\text{ V}$ |     | $V_{CC} = 3.3\text{ V}$<br>$\pm 0.3\text{ V}$ |     | $V_{CC} = 2.7\text{ V}$ |     |      |
|                    |                                 |  |             | MIN   | MAX | MIN   | MAX | MIN                     | MAX |      |
| f <sub>clock</sub> | Clock frequency                 |  |             | 0   | 45  | 0   | 40  | 0                       | 35  | MHz  |
| t <sub>w</sub>     | Pulse duration, CLK high or low |  |             | 9   |     | 10  |     | 13                      |     | ns   |
| t <sub>su</sub>    | Setup time before CLK↑          |  | High or low | 7   |     | 10  |     | 11                      |     | ns   |
| t <sub>h</sub>     | Hold time, data after CLK↑      |  |             | 3   |     | 2   |     | 2                       |     | ns   |

switching characteristics over recommended operating free-air temperature range,  $C_L = 50\text{ pF}$  (unless otherwise noted) (see Figure 1))

| PARAMETER        | FROM<br>(INPUT) | TO<br>(OUTPUT) | SN54LV374                     |     |     |                                 |     |     |                         |     | UNIT |
|------------------|-----------------|----------------|-------------------------------|-----|-----|---------------------------------|-----|-----|-------------------------|-----|------|
|                  |                 |                | V <sub>CC</sub> = 5 V ± 0.5 V |     |     | V <sub>CC</sub> = 3.3 V ± 0.3 V |     |     | V <sub>CC</sub> = 2.7 V |     |      |
|                  |                 |                | MIN                           | TYP | MAX | MIN                             | TYP | MAX | MIN                     | MAX |      |
| f <sub>max</sub> |                 |                | 45                            | 80  |     | 40                              | 70  |     | 35                      |     | MHz  |
| t <sub>pd</sub>  | CLK             | Q              |                               | 11  | 19  |                                 | 15  | 24  |                         | 29  | ns   |
| t <sub>en</sub>  | $\overline{OE}$ | Q              |                               | 10  | 20  |                                 | 13  | 24  |                         | 28  | ns   |
| t <sub>djs</sub> | $\overline{OE}$ | Q              |                               | 8   | 21  |                                 | 12  | 24  |                         | 29  | ns   |

switching characteristics over recommended operating free-air temperature range,  $C_L = 50\text{ pF}$  (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM<br>(INPUT) | TO<br>(OUTPUT) | SN74LV374                     |     |     |                                 |     |     |                         |     | UNIT |
|------------------|-----------------|----------------|-------------------------------|-----|-----|---------------------------------|-----|-----|-------------------------|-----|------|
|                  |                 |                | V <sub>CC</sub> = 5 V ± 0.5 V |     |     | V <sub>CC</sub> = 3.3 V ± 0.3 V |     |     | V <sub>CC</sub> = 2.7 V |     |      |
|                  |                 |                | MIN                           | TYP | MAX | MIN                             | TYP | MAX | MIN                     | MAX |      |
| f <sub>max</sub> |                 |                | 45                            | 80  |     | 40                              | 70  |     | 35                      |     | MHz  |
| t <sub>pd</sub>  | CLK             | Q              |                               | 11  | 19  |                                 | 15  | 24  |                         | 29  | ns   |
| t <sub>en</sub>  | $\overline{OE}$ | Q              |                               | 10  | 20  |                                 | 13  | 24  |                         | 28  | ns   |
| t <sub>djs</sub> | $\overline{OE}$ | Q              |                               | 8   | 21  |                                 | 12  | 24  |                         | 29  | ns   |

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**WITH 3-STATE OUTPUTS**

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**operating characteristics,  $T_A = 25^\circ\text{C}$**

| PARAMETER       |                  | TEST CONDITIONS                       | V <sub>CC</sub> | TYP | UNIT |
|-----------------|------------------|---------------------------------------|-----------------|-----|------|
| C <sub>pd</sub> | Outputs enabled  | C <sub>L</sub> = 50 pF,    f = 10 MHz | 3.3 V           | 52  | pF   |
|                 | Outputs disabled |                                       |                 | 34  |      |
|                 | Outputs enabled  |                                       | 5 V             | 60  |      |
|                 | Outputs disabled |                                       |                 | 35  |      |



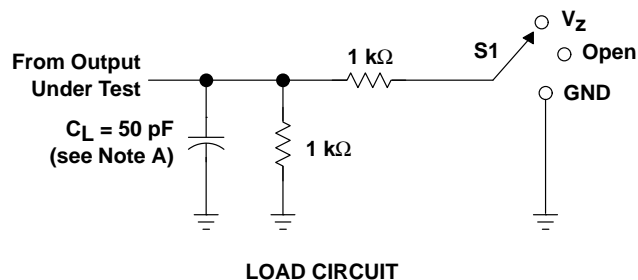
# SN54LV374, SN74LV374

## OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

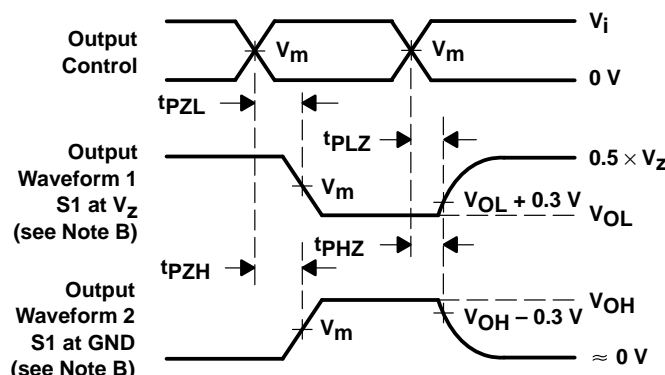
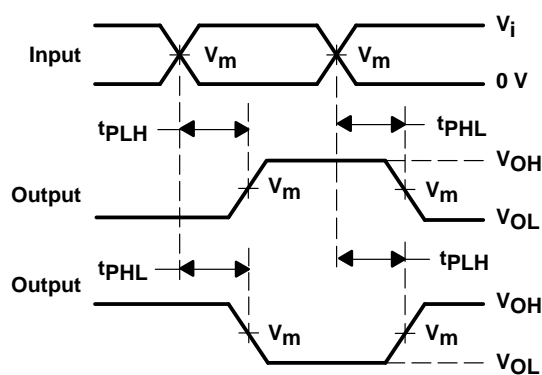
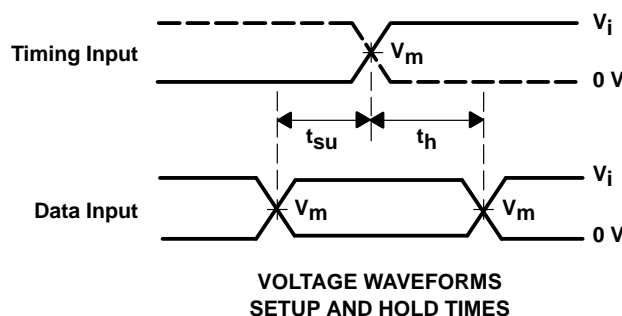
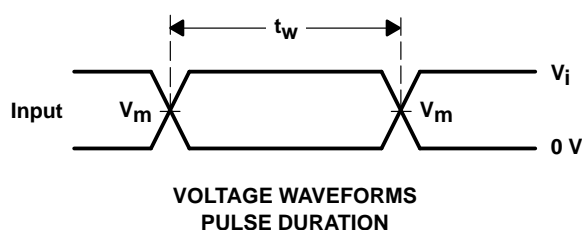
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#### PARAMETER MEASUREMENT INFORMATION



| TEST                               | S1             |
|------------------------------------|----------------|
| t <sub>PLH</sub> /t <sub>PHL</sub> | Open           |
| t <sub>PLZ</sub> /t <sub>PZL</sub> | V <sub>Z</sub> |
| t <sub>PHZ</sub> /t <sub>PZH</sub> | GND            |

| WAVEFORM CONDITION | V <sub>CC</sub> = 4.5 V to 5.5 V | V <sub>CC</sub> = 2.7 V to 3.6 V |
|--------------------|----------------------------------|----------------------------------|
| V <sub>m</sub>     | 0.5 × V <sub>CC</sub>            | 1.5 V                            |
| V <sub>i</sub>     | V <sub>CC</sub>                  | 2.7 V                            |
| V <sub>Z</sub>     | 2 × V <sub>CC</sub>              | 6 V                              |



- NOTES:
- $C_L$  includes probe and jig capacitance.
  - Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
  - All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z<sub>O</sub> = 50 Ω, t<sub>r</sub> ≤ 2.5 ns, t<sub>f</sub> ≤ 2.5 ns.
  - The outputs are measured one at a time with one transition per measurement.
  - t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.
  - t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.
  - t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>pd</sub>.

Figure 1. Load Circuit and Voltage Waveforms

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